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(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
12.05.1999 Bulletin 1999/19

(51) Int. Cl.<sup>6</sup>: **H04L 29/06**, **H04L 12/56**,  
**H04L 12/18**

(21) Application number: **98118038.3**

(22) Date of filing: **23.09.1998**

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU**  
**MC NL PT SE**  
Designated Extension States:  
**AL LT LV MK RO SI**

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(30) Priority: **30.10.1997 US 960799**

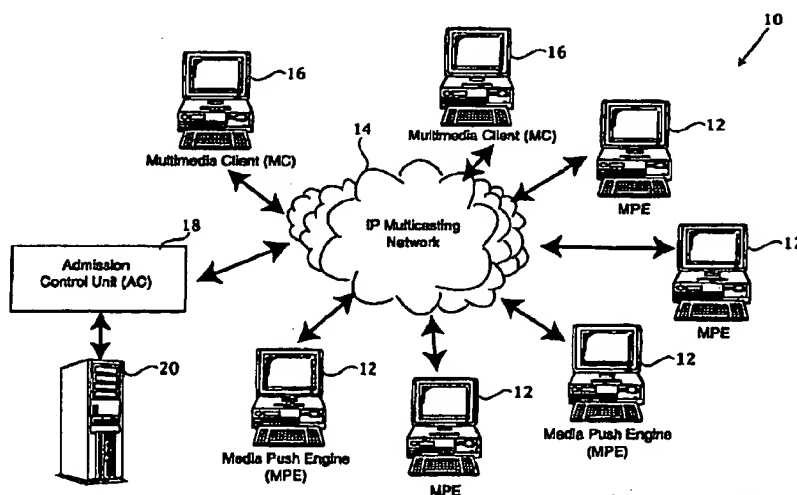
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(54) **Distributed internet protocol-based real-time multimedia streaming architecture**

(57) Multiple media push engines communicate with the multimedia client through a multi casting network that may incorporate multiple delivery paths. The streaming data representing media selections for delivery are distributed across multiple media push engines using a non-hierarchical coding technique in which the data are represented as a set of substream components, capable of being reconstituted from fewer than all of the components of the original data stream. The higher the number of components used in reconstitution, the higher the quality of service is provided by the

reconstituted stream. Admission control to the group multicast session is administered in a distributed fashion, where an admission control unit opens the multicast stream, with all subsequent admission control decisions being made by the media push engines themselves. Substream component data are sent using Real-Time transport protocol while session management and the distributed admission control process are administered under the Real-Time Control Protocol.



**FIGURE 1**

## Description

### Background and Summary of the Invention

[0001] The present invention relates generally to networked multimedia systems. More particularly, the invention relates to a media delivery system for delivering media selections to one or more media clients over a multicasting network.

[0002] With the explosive growth of the Internet, there is a growing interest in using the Internet and other Internet protocol-based networks to deliver multimedia selections, such as video and audio material. Interactive television, movies on demand, and other multimedia push technologies are among the more promising applications.

[0003] The Internet is a connectionless network offering best effort delivery service. Packets of data are routed as datagrams that carry the address of the intended recipient. A specific connection between the sender and the recipient is not required, because all host nodes on the network include the inherent capability to route datagrams from node to node until delivery is effected. This datagram packet delivery scheme is constructed as a best effort delivery system in which the delivery of datagram packets is not guaranteed. Datagram packets may be sent via different routes in the effort to increase the likelihood of delivery. Thus, if one node on the network is experiencing congestion, subsequent datagrams may be alternately routed to avoid the congested node. This means that data datagram packets do not inherently have a guaranteed arrival time. Even packets corresponding to a single message may be received out of order. This fact significantly affects how certain multimedia data are delivered.

[0004] In many cases, multimedia data require real-time delivery. In the case of audio or video data, the data stream representing a particular media selection needs to be delivered in the proper time sequence, to allow the user to play back the audio or video selection "live" as it is being sent. Clearly, if the datagram packets are delivered out of order, due to taking different delivery routes, then playback at the multimedia client (e.g., a user's interactive TV) will be jumbled.

[0005] The Real-time Protocol (RTP) is a current *de facto* standard for delivering real-time content over the Internet (or other networks based on an IP protocol). The Real-time Protocol replaces the conventional transmission control protocol (TCP) with a framework that real-time applications can use directly for data transport. Currently, the RTP standard supports a first type of message, namely one for carrying the media content data or streaming data. Typically, a separate protocol, the Real-Time Control Protocol (RTCP) is used with RTP to pass control messages for session management, rate adaptation and the like.

[0006] While the Real-time Protocol can be used to deliver multimedia streaming data over computer net-

works, the existing architecture has not proven robust enough to provide high quality presentation using best effort network services such as those provided by the Internet. The present invention solves this problem by using a distributed media push architecture that is capable of supplying streaming data redundantly from multiple sources and over multiple distribution paths. The media push engines have associated media storage units that store streaming data as non-hierarchical sets of substream components. The components are capable of being reconstituted into a reconstructed stream from fewer than all of the components, such that the higher the number of components used in reconstitution, the higher the quality of the reconstructed stream.

[0007] Conventional systems use a hierarchical coding scheme that treats some components as more important than others. Thus, conventional systems typically need to expend considerable resources to guarantee that the more important components are always delivered. In contrast, the media delivery system of the invention uses a non-hierarchical coding scheme, multiple description coding (MDC) that treats all components as equals. Thus, no special resources need to be allocated to ensure that a given set of substream components is delivered. Naturally, the higher number of components delivered, the higher the quality achieved; on the other hand, unlike with conventional hierarchical coding, loss of any given single packet does not appreciably degrade the signal quality.

[0008] The distributed media delivery system also employs a distributed admission control system. The media client contacts a single admission control unit to request a given media selection, but thereafter the admission control decisions are handled in distributed fashion by the media push engines themselves. The admission control unit communicates the request to a plurality of media push engines distributed across the network and those push engines individually determine whether they can participate in the multicasting session. Thus, the individual media push engines each evaluate local traffic congestion to determine whether it is capable of supplying the requested data stream. The admission control unit is thus not involved in directly determining which media push engines should be admitted to a multicast group session. The admission control unit simply assigns the multicast group session address and then allows the admission process to proceed autonomously, in a distributed fashion.

[0009] For a more complete understanding of the invention, its objects and advantages, reference may be had to the following specification and to the accompanying drawings.

### Brief Description of the Drawings

[0010]

Figure 1 is a network datagram illustrating a pre-